

Appendix G
**Wastewater Treatment
Business Case
Evaluation**

February 2017



Submitted to:

**CITY OF
WICHITA**

Public Works
and Utilities



Submitted by:

In Association with:



Appendix G—Wastewater Treatment Business Case Evaluation

Biological Nutrient Removal, City of Wichita, Sewage Treatment Division

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CH2M Project NO.: 668927

1.0 Introduction

The City of Wichita (the City), Department of Public Works and Utilities (the Utility), Sewage Treatment Division, uses a business case evaluation (BCE) process for making balanced decisions related to important capital investments regarding asset rehabilitation, renewal, or replacement options. The BCE process provides a framework for evaluating alternative solutions for every capital project(s) and evaluates those solutions against financial, environmental, and community and social values and benefits. The goal of the BCE process is to make consistent and defensible decisions regarding capital investment that meet the Utility's strategic plan and are in the best interest of the Utility customers.

Once the BCE process is completed for a given capital investment, the project stakeholders will present the BCE recommendations to Utility management, and possibly Wichita City Council, for approval. Once approved, the BCE recommendations will be incorporated into the Utility's normal 10-year capital improvement program (CIP) process for budgeting and scheduling. The BCE recommendations would then be implemented according to the CIP budget and schedule.

If the project experiences significant changes, then a new BCE process, including updating project costs, should be completed. For example, if regulatory requirements, performance and/or capacity requirements, and/or site location and characteristics change, then project alternatives should be reevaluated to determine the best solution meeting the revised project scope. Project CIP budget and schedule should be revised accordingly. The Utility should consider a change in direction if it provides increased value to the community.

2.0 Project Background

CH2M is helping the Utility develop a water and sewer utility asset management plan, which includes utility optimization and exploring alternative finance and project delivery options. While completing the project, if assets were found to be of high risk and potential imminent failure, then they were to be considered for immediate action or improvements.

Biological nutrient removal (BNR) will be required by the Kansas Department of Health and Environment (KDHE) by the year 2028, with associated necessary actions to meet regulatory requirements. To meet these regulations, the Utility will need to make adjustments to three facilities:

- WQRF 1: Grove Street Pump Station

- WQRF 2: Lower Arkansas River Water Quality Reclamation Facility (WQRF)
- WQRF 5: Mid-Continent WQRF

The City's WQRFs have a total design peak treatment capacity of 75 million gallons per day (MGD). The total permitted treatment capacity is 48 MGD (average daily flow). Currently, the average daily wastewater flow treated is approximately 42 MGD. There are a total five permitted WQRFs. WQRFs 1 and 2 are the oldest facilities, with infrastructure assets dating back to 1957 and earlier.

KDHE is anticipated to require BNR by or before the year 2028 to meet permit requirements. BNR removes total nitrogen (TN) and total phosphorus (TP) from wastewater by using microorganisms. In BNR systems, nitrification is the controlling reaction in aerobic conditions, with nitrogen removal occurring during denitrification under anoxic conditions. Phosphorus occurs in particulate form as well as a soluble form, both of which must be addressed. Particulate phosphorus can be removed during solids removal. Soluble phosphorus can be removed via phosphorus uptake by microorganisms or through chemical precipitation. The master plan, currently being updated, has identified several alternatives of the previously mentioned three WQRFs that could satisfy the BNR requirements while rehabilitating existing facilities. Investment considerations should include capital investment costs as well as operations and maintenance (O&M) costs for true life-cycle cost consideration.

3.0 Improvement Alternatives—Decision Modeling

Improvement alternatives need to be adequately sized to meet current and projected future average day wastewater flows. For this BCE and the updated master plan the current average day wastewater flows are assumed to be 42 MGD. No projected growth is expected in this drainage basin, so future projected average day wastewater flows are also 42 MGD. In addition to considering treatment capacity needed, improvement alternatives should also consider implementation and life-cycle costs over the 40-year planning period. Ten improvement alternatives, shown in Table 3-1, are being considered.

Table 3-1. Improvement Alternatives

Alternative No.	WQRF 1/ WQRF 2/WQRF 5 Capacity (MGD)	WQRF 1	WQRF 2	WQRF 5	Forcemain Timing
1	Alternative 1: 0/36/6	Raw wastewater pumped to WQRF 2	BNR upgrade by 2028	Expand to 6 MGD, keep BNR capability	Repair now requiring bypass pumping
2	Alternative 2: 0/36/6 Early	Raw wastewater pumped to WQRF 2	BNR upgrade by 2022	Expand to 6 MGD, keep BNR capability	Repair now requiring bypass pumping
3	Alternative 3: 0/42/0	Raw wastewater pumped to WQRF 2	BNR upgrade by 2028	Decommission	Repair now requiring bypass pumping
4	Alternative 4: 0/42/0 Early	Raw wastewater pumped to WQRF 2	BNR upgrade by 2022	Decommission	Repair now requiring bypass pumping
5	Alternative 5: 24/12/6	BNR upgrade by 2028	Rehabilitate WQRF; BNR may not be required with nutrient trading	Expand to 6 MGD, keep BNR capability	Future repair by 2030 avoiding bypass pumping
6	Alternative 6 - 24/12/6 Early	BNR upgrade by 2022	Rehabilitate WQRF; BNR may not be required with nutrient trading	Expand to 6 MGD, keep BNR capability	Future repair by 2024 avoiding bypass pumping
7	Alternative 7: 24/18/0	BNR upgrade by 2028	Rehabilitate WQRF; BNR may not be required with nutrient trading	Decommission	Future repair by 2030 avoiding bypass pumping

Table 3-1. Improvement Alternatives

Alternative No.	WQRF 1/ WQRF 2/WQRF 5 Capacity (MGD)	WQRF 1	WQRF 2	WQRF 5	Forcemain Timing
8	Alternative 8: 24/18/0 Early	BNR upgrade by 2022	Rehabilitate WQRF; BNR may not be required with nutrient trading	Decommission	Future repair by 2024 avoiding bypass pumping
9	Alternative 9: 24/15/3	BNR upgrade by 2028	Rehabilitate WQRF; BNR may not be required with nutrient trading	Keep 3 MGD and BNR capability, rehabilitate existing WQRF	Future repair by 2030 avoiding bypass pumping
10	Alternative 10: 24/15/3 Early	BNR upgrade by 2022	Rehabilitate WQRF; BNR may not be required with nutrient trading	Keep 3 MGD and BNR capability, rehabilitate existing WQRF	Future repair by 2024 avoiding bypass pumping

With the improvement alternatives identified, decision modeling criteria, cost estimating, and evaluation of the improvement alternatives benefit-to-cost ratios should be completed. For this BCE, decision-modeling criteria pertaining to regulatory compliance, public confidence (disruptions and complaints), fiscal impact, environmental and public health impacts, system reliability, and employee health and safety were developed and weighted with respect to each other. These criteria will be used to determine which alternative provides the highest benefit to the utility and its customers. The decision-modeling criteria and weighting are shown in Table 3-2.

Table 3-2. Decision-Modeling Criteria Weighting

Project Service Criteria		A	B	C	D	E	F	Total Scores	Weighting Percentage	Relative Weights
		Regulatory Compliance	Public Confidence	Fiscal Impact	Environmental and Public Health Impact	System Reliability	Employee Health and Safety			
A	Regulatory Compliance	A	4	5	3	4	4	20	22.22	22.22
B	Public Confidence	2	B	5	2	2	4	15	16.67	16.67
C	Fiscal Impact	1	1	C	1	1	1	5	5.56	5.56
D	Environmental and Public Health Impact	3	4	5	D	3	4	19	21.11	21.11
E	System Reliability	2	4	5	3	E	4	18	20.00	20.00
F	Employee Health and Safety	2	2	5	2	2	F	13	14.44	14.44
Totals								90	100.00	100

4.0 Improvement Alternatives—Cost Estimating

Improvement alternative life-cycle cost estimates are typically critical decision points in determining which improvement alternative is the best solution to the problem. The life-cycle cost needs to be developed as accurately as possible, however during most BCE evaluations, the evaluation of improvement alternatives occurs during the project's conceptual screening or feasibility stages.

The Association for the Advancement of Cost Engineering International (AACE) guidelines should be used when developing cost estimates and understanding the cost estimate class and corresponding accuracy. Table 4-1 describes each cost estimate class and accuracy.

Table 4-1. AACE Cost Estimate Classification System

Estimate Class	Estimate Purpose	Level of Project Definition	Expected Accuracy Range
Class 5	Concept Screening	0% to 2%	-50% to +100%
Class 4	Study or Feasibility	1% to 15%	-30% to + 50%
Class 3	Preliminary Budget Authorization or Control	10% to 40%	-20% to +30%
Class 2	Detailed Budget Authorization or Control	30% to 70%	-15% to +20%
Class 1	Bidding Estimate	50% to 100%	-10% to 15%

Final costs of the project and resulting feasibility will depend on actual labor and material costs, competitive market conditions, actual site conditions, final project scope, implementation schedule, continuity of personnel and engineering, and other variable factors. However, to be able to compare improvement alternatives fairly, as well as projects competing for limited available funding, the following cost guidelines were utilized.

- Project capital costs
 - Vendor quotes and recent bid unit pricing when practical.
 - Additional project costs—Costs calculated as a percentage of the project cost utilizing the following markups. The percentage ranges depending on project characteristics and level of detail.
 - Overall site work: 1% to 5%
 - Yard electrical: 3% to 7%
 - Yard piping: 3% to 9%
 - Supervisory control and data acquisition control systems: 0% to 2%
 - Contractor markups—Costs calculated as a percentage applied to the sum of the project costs including additional project costs. The following contractor markups are used and applied cumulatively in the following order:
 - Overhead: 10%
 - Profit: 5%
 - Mobilization, bonds, and insurance: 5%
 - Construction contingency; 15% to 50%
 - Nonconstruction project costs—Costs are calculated as a percentage applied to the sum of the project costs, additional project costs, and contractor markups. The following nonconstruction costs are typically used and are not applied cumulatively:
 - City internal costs: 3% to 13%

- Permitting: 1% to 3%
- Engineering and design: 8% to 12%
- Services during construction: 8% to 12%
- Commissioning and start-up: 1% to 5%
- Legal and administration: 1% to 3%
- Project financing costs: 5% to 10%
- Other assumptions:
 - Annual discount rate: 5.5%
 - Typical financing cost: 8.0%
 - Annual inflation rate: 3.0%
 - Typical project service life: 20 to 30 years
 - Typical financing term: 20 to 30 years
- Project O&M costs
 - Average labor rate (includes benefits): \$30 per hour
 - Power costs: \$0.07 per kilowatt-hour
 - Chemicals costs: use vendor quotes

5.0 Improvement Alternative Evaluations

5.1 Benefit Scoring

With the improvement alternatives identified, the benefits of each alternative have been scored based on the decision criteria categories with respect to one another. The scores are then normalized based on the criteria weighting determined in Section 3. Tables 5-1 and 5-2 show the results of the benefit scoring.

Using the results of Tables 5-1 and 5-2, Figure 5-1 was developed. From this figure, it can be easily determined which alternative is most attractive from a benefit scoring perspective. It is important to note that Figure 5-1 is benefits only and does not include any life-cycle cost information, which will be compared in the next subsection.

Table 5-1. Evaluation of Alternatives—Raw Benefit Scores

Criteria		Alternatives' Raw Scores									
		1	2	3	4	5	6	7	8	9	10
A	Regulatory Compliance	3.00	4.00	1.00	2.00	9.00	10.00	5.00	6.00	7.00	8.00
B	Public Confidence	10.00	10.00	8.00	8.00	6.00	6.00	6.00	6.00	6.00	6.00
C	Fiscal Impact	5.00	6.00	3.00	4.00	9.00	10.00	5.00	6.00	9.00	10.00
D	Environmental and Public Health Impact	4.00	4.00	2.00	2.00	10.00	10.00	6.00	6.00	8.00	8.00
E	System Reliability	4.00	4.00	2.00	2.00	10.00	10.00	6.00	6.00	10.00	10.00
F	Employee Health and Safety	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Totals		31	33	21	23	49	51	33	35	45	47

Table 5-2. Evaluation of Alternatives—Weighted Benefit Scores

Criteria		Alternatives' Weighted Benefit Scores									
		1	2	3	4	5	6	7	8	9	10
A	Regulatory Compliance	0.67	0.89	0.22	0.44	2.00	2.22	1.11	1.33	1.56	1.78
B	Public Confidence	1.67	1.67	1.33	1.33	1.00	1.00	1.00	1.00	1.00	1.00
C	Fiscal Impact	0.28	0.33	0.17	0.22	0.50	0.56	0.28	0.33	0.50	0.56
D	Environmental and Public Health Impact	0.84	0.84	0.42	0.42	2.11	2.11	1.27	1.27	1.69	1.69
E	System Reliability	0.80	0.80	0.40	0.40	2.00	2.00	1.20	1.20	2.00	2.00
F	Employee Health and Safety	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
Totals		4.98	5.26	3.27	3.54	8.33	8.61	5.58	5.86	7.47	7.74

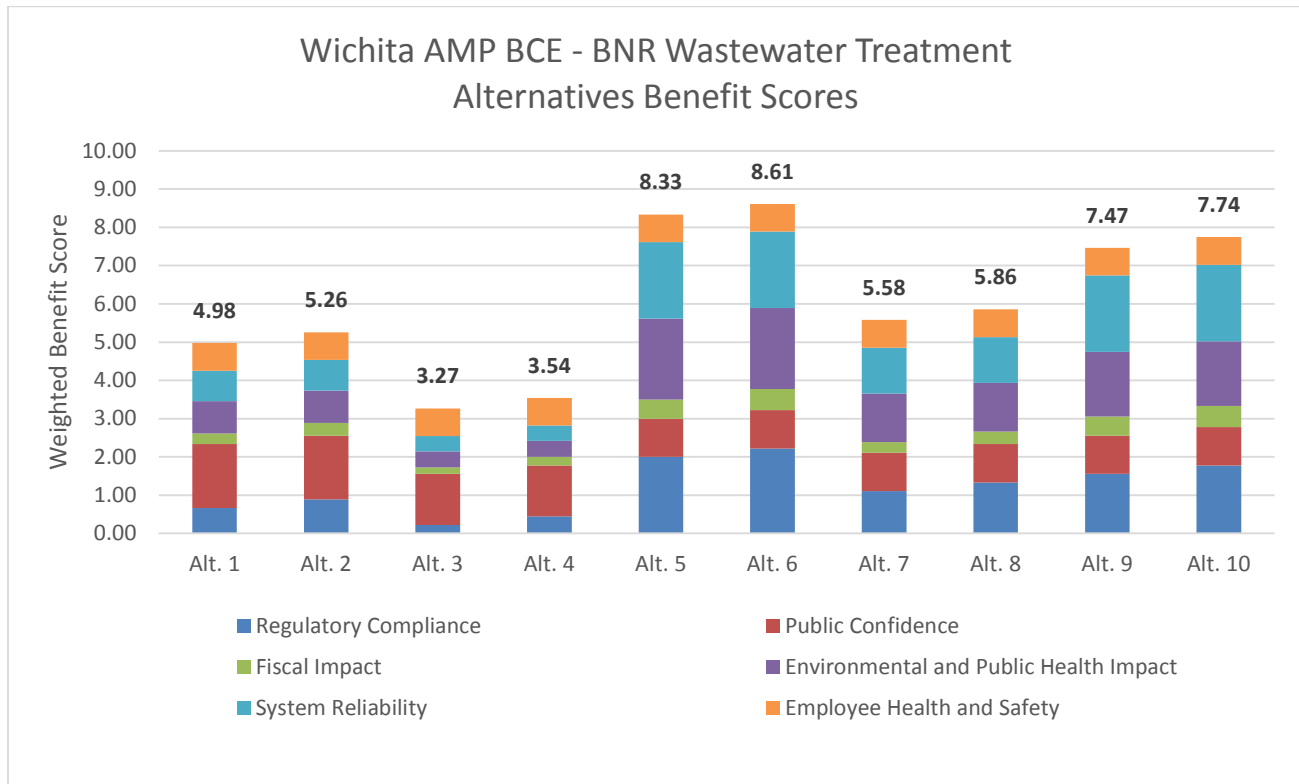


Figure 5-1. Normalized Project Service Benefit Scores

5.2 Benefit to Net Present Value Scoring

The improvement alternatives are compared based on the immediate project capital cost, long-term present value (PV) of capital costs associated with 20 years of proposed master plan projects and the PV of associated long-term annual O&M cost. The total PV cost can be normalized based on the lowest priced alternative and a benefit-to-normalized-PV score ratio can be established for each alternative. Attachment A includes a table of total PV and benefit-to-PV ratios. A higher benefit-to-normalized-PV score indicates a higher benefit per dollar spent for a given alternative. Figure 5-2 represents how different alternatives are evaluated.

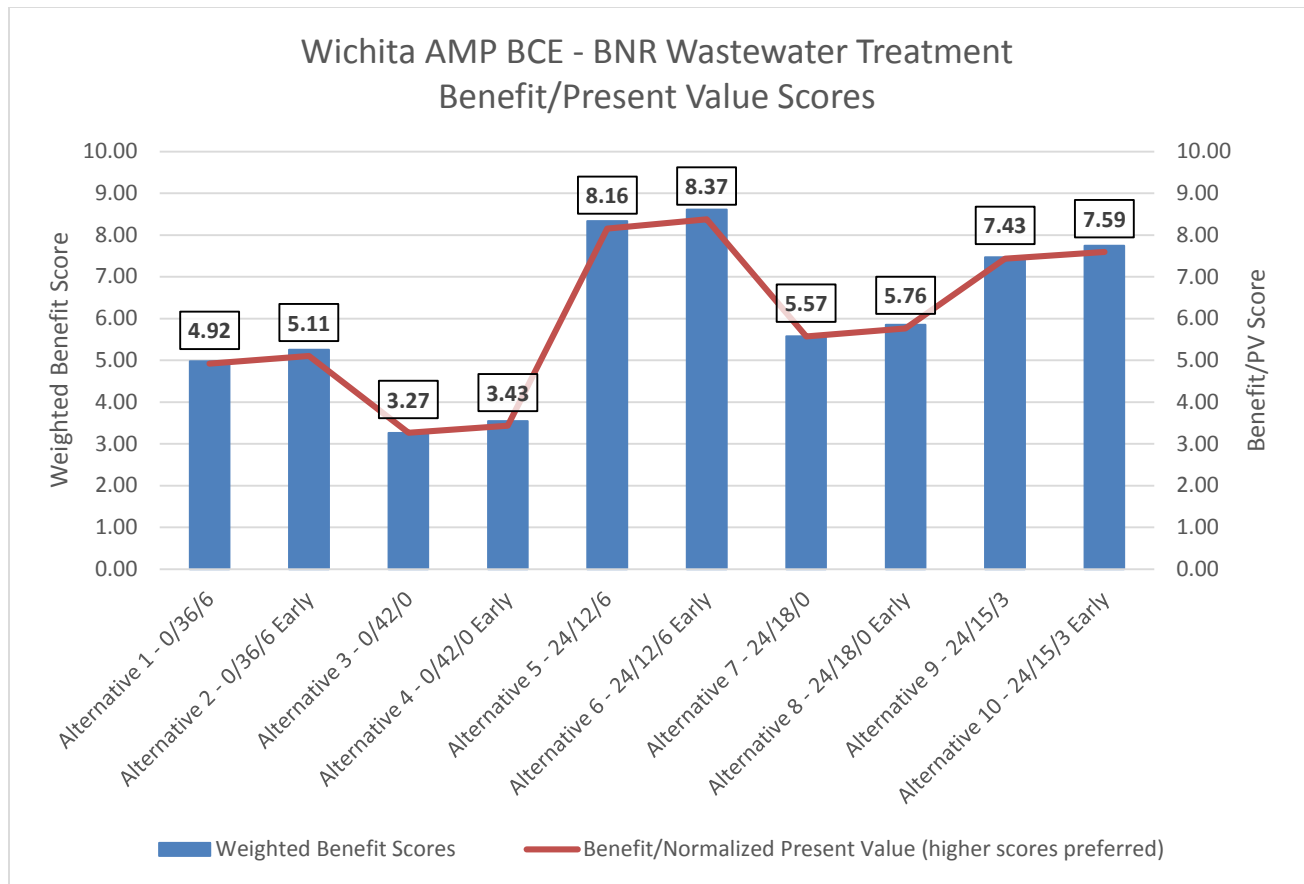


Figure 5-2. Benefit Scores and Benefit/Net PV for Improvement Alternatives

The improvement alternatives can be compared based on the PV to total, firm, and redundant WQRF treatment capacities. Total treatment capacity is the total treatment online assuming all equipment operating. Firm treatment capacity is the amount of treatment capacity online assuming the single largest treatment train is nonfunctional, either due to routine maintenance or an emergency event. Redundant WQRF treatment capacity is the available total capacity of completely independent treatment WQRFs, assuming the largest WQRF is nonfunctional either due to routine maintenance or an emergency event.

5.3 Probability of Consequence Scoring

Each alternative should be evaluated for risk or probability of a consequence of failure occurring. Table 5-3 indicates the possible consequences being considered, an example of an event that could create a failure and, therefore, the consequence to occur and the methodology used to develop the probability of the consequence of failure. Figure 5-3 represents the probability of consequence occurring throughout the 40-year planning period for each improvement alternative.

Table 5-3. Probability of Consequence Methodology

Consequence	Example of Events	Probability Methodology
Permit violation	Ammonia, pH, E. Coli water quality issues	1-percent probability
Temporary reduced capacity, less than 160 MGD peak	Critical Equipment Failures, Piping Failure	Equipment 2- to 10-percent based on age and lifespan
Out of service, 1 day to 2 weeks	Major and/or multiple critical equipment failures, piping or forcemain failure	Equipment 0.5- to 5-percent, based on age and lifespan, forcemain separate probability
Out of service, more than 2 weeks	Tornado, critical fire, terrorism	Tornado 0.1 percent, fire 0.1- to 2-percent based on age, terrorism 0.1-percent

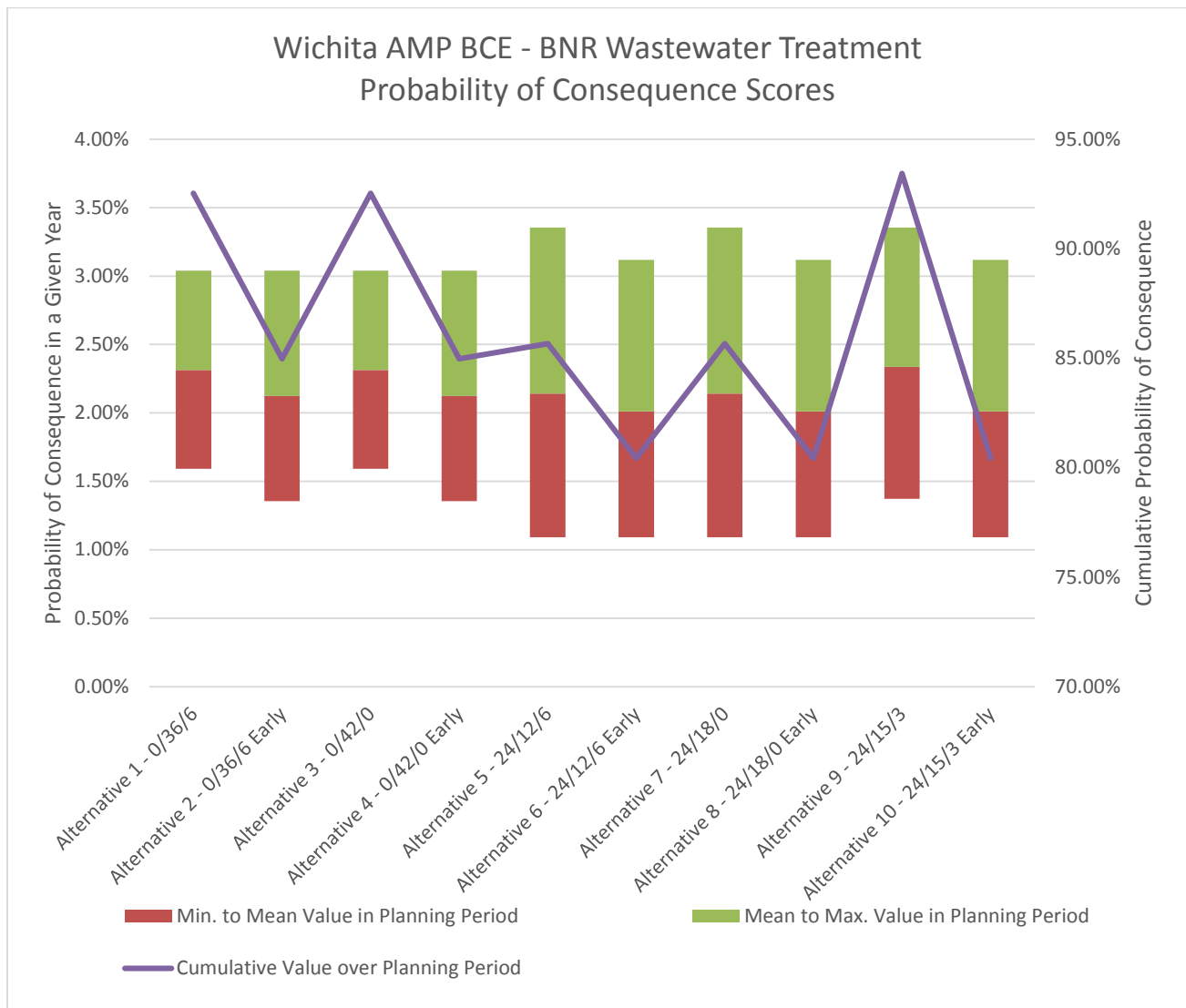


Figure 5-3. Probability of Consequence

6.0 Conclusions

Reviewing the BNR wastewater treatment, five viable improvement alternatives are available, and each can be delivered immediately with treatment capacity being available by 2022, or each can be delivered in the

future with treatment capacity being available in 2028 just when the BNR regulatory requirements are anticipated to be implemented. The BCE considered ten improvement alternatives based on the following:

- Total, firm, and redundant WQRF treatment capacity
- Noneconomic benefit scoring
- Probability of consequence
- Total PV
- Various ratios of scores and total present value

Table 5-4 represents a ranking score, 1 through 10, for each improvement alternatives and BCE evaluation criterion. When comparing improvement alternatives to each other, the improvement alternative with the best score received a ranking of 1.

Table 5-4. Ranking of Improvement Alternatives

BCE Evaluation Criteria	Alternatives' Rankings									
	1	2	3	4	5	6	7	8	9	10
Benefit	8	7	10	9	2	1	6	5	4	3
Cumulative probability of consequence	8	4	8	4	6	1	6	1	10	1
Total PV	4	9	1	10	7	8	2	5	3	6
Total PV/total WQRF capacity	4	9	1	10	7	8	2	5	3	6
Benefit/normalized total PV	8	7	10	9	2	1	6	5	4	3
Total PV/benefit	8	7	10	9	2	1	6	5	4	3
Cumulative Probability of consequence times normalized total PV	9	5	8	7	6	3	4	1	10	2
TPV/cumulative probability of consequence	9	4	8	5	7	3	6	1	10	2
Noneconomic total ranking scores	16	11	18	13	8	2	12	6	14	4
Economic total ranking scores	42	41	38	50	31	24	26	22	34	22
Total ranking scores	58	52	56	63	39	26	38	28	48	26
Noneconomic rank	9	5	10	7	4	1	6	3	8	2
Economic rank	9	8	7	10	5	3	4	1	6	1
Overall rank	9	7	8	10	5	1	4	3	6	1

The results indicate that improvement alternatives that implement BNR treatment capability at the WQRF 1 site are favorable. The top three improvement alternatives also suggest constructing the BNR facility early by 2022 as opposed to late by 2028. These results are driven by the benefits and risk reduction of pumping extraneous flow instead of raw sewage through the forcemain between WQRFs 1 and 2 and the benefit of having WQRF 2 being a partial backup to WQRF 1. However, there are greater life-cycle costs associated with early delivery of BNR treatment due to the added O&M costs of BNR treatment. Following is a summary of the top three overall improvement alternatives.

- **Alternative 10**—Construct 24 MGD of BNR capacity at WQRF 1 by 2022, rehabilitate WQRF 2 to 15 MGD, and keep WQRF 5 at 3 MGD
- **Alternative 6**—Construct 24 MGD of BNR capacity at WQRF 1 by 2022, rehabilitate WQRF 2 to 12 MGD, and expand WQRF 5 to 6 MGD

- **Alternative 8**—Construct 24 MGD of BNR capacity at WQRF 1 by 2022, rehabilitate WQRF 2 to 18 MGD, and decommission WQRF 5

The three top improvement alternatives are essentially tied and the only difference is what to do at WQRF 5. With an investment at WQRF 1 being favorable, the advantage of maintaining or increasing the capacity of WQRF 5 is that WQRF 5 meets BNR requirements and with nutrient trading, which must be negotiated with KDHE; it is possible to not improve WQRF 2 to accommodate BNR treatment. Table 6-1 indicates the possible benefits to WQRF 2 improvements with nutrient trading. Taking flow and loading away from WQRF 2 and providing minor adjustments to the process should allow for cost savings and less improvements at the WQRF 2 site. These potential benefits are only possible with WQRF 5 at maximum capacity.

Table 6-1. Possible Nutrient Trading Benefits

		Average MGD	TN, mg/L	TP, mg/L	TN, ppd	TP, ppd
Current	WQRF 2	39	30.00	3.50	9,758	1,138
	WQRF 5	3	8.00	1.00	200	25
	Total	42			9,958	1,163
Proposed BNR	WQRF 2	39	8.00	1.00	2,602	325
	WQRF 5	3	8.00	1.00	200	25
	Total	42			2,802	350
Proposed BNR with WQRF 1	WQRF 1	24	5.00	0.75	1,001	150
	WQRF 2	12	15.50	1.62	1,551	162
	WQRF 5	6	5.00	0.75	250	38
	Total	42			2,802	350

mg/L milligrams per liter
ppd pounds per day

While the BCE benefit scores do consider treatment facility and odor potential, it does not consider political drivers to invest at certain treatment facilities such as the WQRF 1 site. In addition, the BCE did account for risk in a delayed investment in the forcemain between WQRFs 1 and 2; however, the Utility may not choose to accept this delay.

If political drivers are not willing to consider constructing a BNR treatment facility at the WQRF 1 site, then improvement alternatives 5 through 10 would not be considered. In this situation, assuming only the first four improvement alternatives are considered, the following improvement alternatives are recommended in the following order from highest priority to lowest priority.

- **Alternative 2**—Construct 36 MGD of BNR capacity at WQRF 2 by 2022 and expand WQRF 5 to 6 MGD
- **Alternative 3**—Construct 42 MGD of BNR capacity at WQRF 2 by 2028 and decommission WQRF 5
- **Alternative 1**—Construct 36 MGD of BNR capacity at WQRF 2 by 2028 and expand WQRF 5 to 6 MGD
- **Alternative 4**—Construct 42 MGD of BNR capacity at WQRF 2 by 2022 and decommission WQRF 5

Attachment A

Supporting Documents

Wichita AMP BCE Decision Modeling - BNR

Non-Monetary Decision Criteria and Weights

Project Service Criteria		A	B	C	D	E	F	Total Scores	Weighting Percentage	Relative Weights
		Regulatory Compliance	Public Confidence	Fiscal Impact	Environmental and Public Health Impact	System Reliability	Employee Health and Safety			
A	Regulatory Compliance	A	4	5	3	4	4	20	22.22%	22.22
B	Public Confidence	2	B	5	2	2	4	15	16.67%	16.67
C	Fiscal Impact	1	1	C	1	1	1	5	5.56%	5.56
D	Environmental and Public Health Impact	3	4	5	D	3	4	19	21.11%	21.11
E	System Reliability	2	4	5	3	E	4	18	20.00%	20.00
F	Employee Health and Safety	2	2	5	2	2	F	13	14.44%	14.44
Totals								90	100.00%	100

Scores

- 5 = Significantly More Important
- 4 = More Important
- 3 = Equal in Importance
- 2 = Less Important
- 1 = Significantly Less Important

Instructions (for each Non-Monetary Decision Criteria and Weights scoring table):

- 1) Edit criteria in column B. Select criteria categories based on the project being evaluated. Criteria can be project service based when deciding between project alternatives or can be project delivery based when the project alternative is decided but trying to decide on optimal project delivery. Ten (10) criteria rows/columns are shown but the user does not need to use all 10 if not needed.
- 2) Edit numbers in the yellow cells. When doing this ask if the criteria in Column B is more or less important than criteria in Row 5. If Column B is more important, than the number in yellow will be

Potential criteria categories for consideration:

Project service based criteria categories:

levels of service, regulatory compliance, system reliability, environmental and public health impacts, employee health and safety, public confidence (disruptions and complaints), financial impacts, flexibility/risk, adaptability/phasing, proven experience, staffing, multiple processes, land/building requirements, sidestream impacts, social impacts

Wichita AMP BCE Decision Modeling - BNR

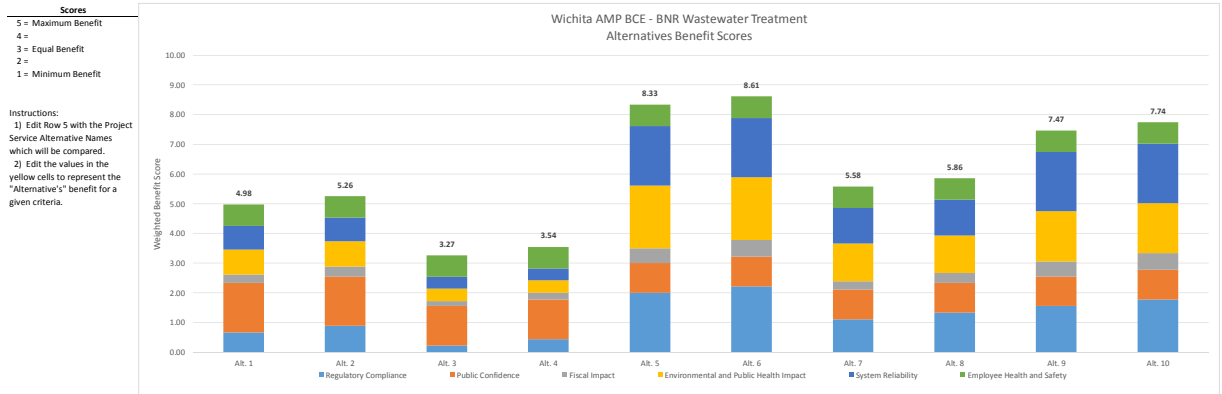
	Alternative 1 - 0/36/6	Alternative 2 - 0/36/6 Early	Alternative 3 - 0/42/0	Alternative 4 - 0/42/0 Early	Alternative 5 - 24/12/6	Alternative 6 - 24/12/6 Early	Alternative 7 - 24/18/0	Alternative 8 - 24/18/0 Early	Alternative 9 - 24/15/3	Alternative 10 - 24/15/3 Early
Plant 1	0	0	0	0	24	24	24	24	24	24
Plant 2	36	36	42	42	12	12	18	18	15	15
Plant 5	6	6	0	0	6	6	0	0	3	3
Force Main Construction	Now	Now	Now	Now	Future	Future	Future	Future	Future	Future
Total Capacity	42	42	42	42	42	42	42	42	42	42
Fiscal Impact Score										
Public Confidence										
Env and Public Health										
Employee HSSE										
Demolition	\$ -	\$ -	\$ 5,000,000	\$ 5,000,000	\$ -	\$ -	\$ 5,000,000	\$ 5,000,000	\$ -	\$ -
CIP PV	\$ 325,100,000	\$ 325,100,000	\$ 330,000,000	\$ 330,000,000	\$ 401,100,000	\$ 401,100,000	\$ 386,000,000	\$ 386,000,000	\$ 390,400,000	\$ 390,400,000
O&M PV	\$ 958,344,000	\$ 980,025,000	\$ 938,634,000	\$ 980,025,000	\$ 894,834,000	\$ 903,375,000	\$ 883,665,000	\$ 903,375,000	\$ 883,665,000	\$ 903,375,000
Total PV	\$ 1,283,444,000	\$ 1,305,125,000	\$ 1,273,634,000	\$ 1,315,025,000	\$ 1,295,934,000	\$ 1,304,475,000	\$ 1,274,665,000	\$ 1,294,375,000	\$ 1,274,065,000	\$ 1,293,775,000
Total PV / Total Capacity	\$ 30.56	\$ 31.07	\$ 30.32	\$ 31.31	\$ 30.86	\$ 31.06	\$ 30.35	\$ 30.82	\$ 30.33	\$ 30.80
Total CIP/Total Capacity	\$ 7.74	\$ 7.74	\$ 7.98	\$ 7.98	\$ 9.55	\$ 9.55	\$ 9.31	\$ 9.31	\$ 9.30	\$ 9.30
Benefit/Normalized Present Value	4.92	5.11	3.27	3.43	8.16	8.37	5.57	5.76	7.43	7.59
PV/Benefit (lowest value preferred)	\$ 257,840,000	\$ 248,340,000	\$ 388,360,000	\$ 369,600,000	\$ 155,520,000	\$ 151,490,000	\$ 227,630,000	\$ 220,200,000	\$ 170,640,000	\$ 167,060,000

	Alternative 1 - 0/36/6	Alternative 2 - 0/36/6 Early	Alternative 3 - 0/42/0	Alternative 4 - 0/42/0 Early	Alternative 5 - 24/12/6	Alternative 6 - 24/12/6 Early	Alternative 7 - 24/18/0	Alternative 8 - 24/18/0 Early	Alternative 9 - 24/15/3	Alternative 10 - 24/15/3 Early
Benefit/Normalized Present Value	8	7	10	9	2	1	6	5	4	3
PV/Benefit (lowest value preferred)	8	7	10	9	2	1	6	5	4	3
Total PV / Total Capacity	4	9	1	10	7	8	3	6	2	5
Risk?										
Total	20	23	21	28	11	10	15	16	10	11
Rank	7	9	8	10	3	1	5	6	1	3

Wichita AMP BCE Decision Modeling - BNR

Project Service Criteria		Project Service Alternatives - Raw Scores										Project Service Alternatives - Weighted Benefit Scores										
												Criteria Weighting										
		Alternative 1 - 0/16/6	Alternative 2 - 0/16/6 Early	Alternative 3 - 0/12/0	Alternative 4 - 0/12/0 Early	Alternative 5 - 24/12/6	Alternative 6 - 24/12/6 Early	Alternative 7 - 24/18/0	Alternative 8 - 24/18/0 Early	Alternative 9 - 24/15/3	Alternative 10 - 24/15/3 Early		Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7	Alt. 8	Alt. 9	Alt. 10
A	Regulatory Compliance	3.00	4.00	1.00	2.00	9.00	10.00	5.00	6.00	7.00	8.00	22.22%	0.67	0.89	0.22	0.44	2.00	2.22	1.11	1.33	1.56	1.78
B	Public Confidence	10.00	10.00	8.00	8.00	6.00	6.00	6.00	6.00	6.00	6.00	16.67%	1.67	1.67	1.33	1.33	1.00	1.00	1.00	1.00	1.00	1.00
C	Fiscal Impact	5.00	6.00	3.00	4.00	9.00	10.00	5.00	6.00	9.00	10.00	5.56%	0.28	0.33	0.17	0.22	0.50	0.56	0.28	0.33	0.50	0.56
D	Environmental and Public	4.00	4.00	2.00	2.00	10.00	10.00	6.00	6.00	8.00	8.00	21.11%	0.84	0.84	0.42	0.42	2.11	2.11	1.27	1.27	1.69	1.69
E	System Reliability	4.00	4.00	2.00	2.00	10.00	10.00	6.00	6.00	10.00	10.00	20.00%	0.80	0.80	0.40	0.40	2.00	2.00	1.20	1.20	2.00	2.00
F	Employee Health and Safe	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	14.44%	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
Totals		31	33	21	23	49	51	33	35	45	47	100.00%	4.98	5.26	3.27	3.54	8.33	8.61	5.58	5.86	7.47	7.74
Total Capacity		Alt. 1 42	Alt. 2 42	Alt. 3 42	Alt. 4 42	Alt. 5 42	Alt. 6 42	Alt. 7 42	Alt. 8 42	Alt. 9 42	Alt. 10 42	Future Flows	1.00 100%	1.00 100%	1.00 100%	1.00 100%	1.00 100%	1.00 100%	1.00 100%	1.00 100%	1.00 100%	1.00 100%

Based on redundant p
Based on public visibil
Probability for change
Based on redundant p



[illegible]

Wichita AMP BCE Decision Modeling - BNR

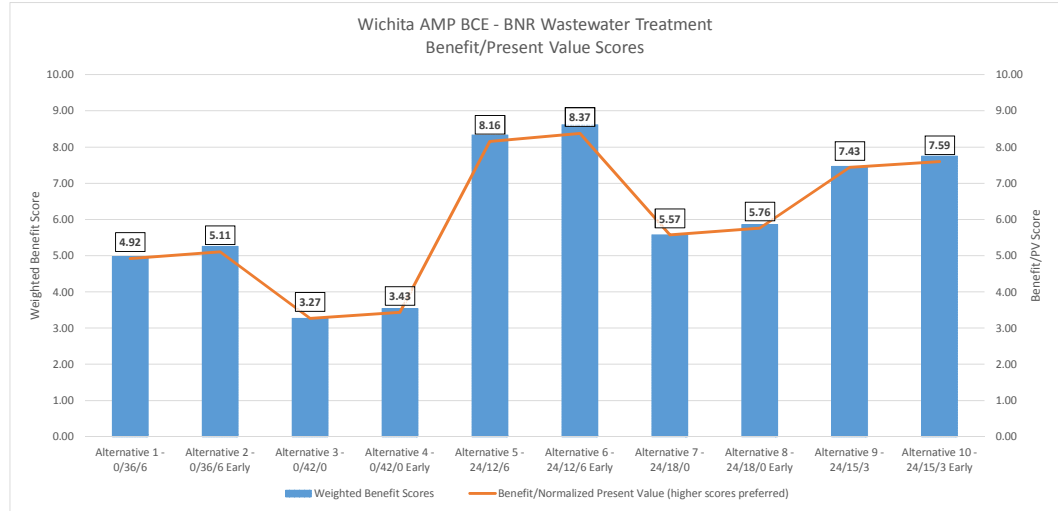
Present Value Scoring

Cost Component	Units	Alternatives									
		Alternative 1 - 0/36/6	Alternative 2 - 0/36/6 Early	Alternative 3 - 0/42/0	Alternative 4 - 0/42/0 Early	Alternative 5 - 24/12/6	Alternative 6 - 24/12/6 Early	Alternative 7 - 24/18/0	Alternative 8 - 24/18/0 Early	Alternative 9 - 24/15/3	Alternative 10 - 24/15/3 Early
Capital Cost PV	2017 dollars, 40 years	\$ 325,100,000	\$ 325,100,000	\$ 330,000,000	\$ 330,000,000	\$ 401,100,000	\$ 401,100,000	\$ 386,000,000	\$ 386,000,000	\$ 390,400,000	\$ 390,400,000
Annual O&M Cost PV	2017 dollars, 40 years	\$ 958,344,000	\$ 980,025,000	\$ 938,634,000	\$ 980,025,000	\$ 894,834,000	\$ 903,375,000	\$ 883,665,000	\$ 903,375,000	\$ 883,665,000	\$ 903,375,000
Total PV Cost	2017 dollars	\$1,283,444,000	\$1,305,125,000	\$1,268,634,000	\$1,310,025,000	\$1,295,934,000	\$1,304,475,000	\$1,269,665,000	\$1,289,375,000	\$1,274,065,000	\$1,293,775,000
Normalized Present Value to Lowest Price Alternative		1.01	1.03	1.00	1.03	1.02	1.03	1.00	1.02	1.00	1.02
Weighted Benefit Scores		4.98	5.26	3.27	3.54	8.33	8.61	5.58	5.86	7.47	7.74
Benefit/Normalized Present Value (higher scores preferred)		4.92	5.11	3.27	3.43	8.16	8.37	5.57	5.76	7.43	7.59
PV/Benefit (lowest value preferred)		\$ 257,840,000	\$ 248,340,000	\$ 388,360,000	\$ 369,600,000	\$ 155,520,000	\$ 151,490,000	\$ 227,630,000	\$ 220,200,000	\$ 170,640,000	\$ 167,060,000

Instructions:

- 1) Alternatives should match and be pulled from the "Service Benefit" tab.
- 2) Edit the PV rate and years, cells C8 and C9, highlighted in yellow.
- 3) Edit the Project Capital Cost and Annual O&M Cost, highlighted in yellow, for each alternative. Values should be in current year dollar values. Costs should include all costs associated with land purchasing, permits, engineering, construction, inspection, engineering services during construction, startup, warranty, power, chemicals, labor, City internal project management costs, etc.

Weighted benefit scores should match and be pulled from the "Service Benefit" tab. A favorable alternative should have a high benefit to Normalized PV Cost or a low PV Cost to benefit.



Component		Capacity, MGD	Number of Trains	O&M Start	O&M Stop
Alternative 1 - 0/36/6	Plant 1	0		1987	2021
	Plant 1	0		2022	2060
	Plant 2	40		1987	2027
	Plant 2	36		2028	2060
	Plant 5	3		2010	2021
	Plant 5	6		2022	2060
	Force Main Now	Raw		1957	2019
	Force Main Future	Raw		2020	2060
Consequences		Event Types	Methodology	Min.	Mean
Permit Violation		Ammonia, pH, E. Coli water quality issues	1% Probability	1.00%	1.00%
Temporary Reduced Capacity, <Half Capacity		Critical Equipment Failures, Piping Failure	Equipment 2.0% to 5% based on age and lifespan	2.36%	3.45%
Out of Service, 1 day to 2 weeks		Major/Multiple Critical Equipment Failures, Piping Failure	Equipment 0.5% to 5% based on age and lifespan, Forcemain Separate	2.48%	3.59%
Out of Service, >2 weeks		Tornado, Critical Fire, Terrorism	Tornado 0.1%, Fire 0.1% to 2% based on age, Terrorism 0.1%	0.53%	1.22%
Average Probability of Consequences			92.53%	1.59%	2.31%
Component		Capacity, MGD	Number of Trains	O&M Start	O&M Stop
Alternative 2 - 0/36/6 Early	Plant 1	0		1987	2021
	Plant 1	0		2022	2060
	Plant 2	40		1987	2021
	Plant 2	36		2022	2060
	Plant 5	3		2010	2021
	Plant 5	6		2022	2060
	Force Main Now	Raw		1957	2019
	Force Main Future	Raw		2020	2060
Consequences		Event Types	Methodology	Min.	Mean
Permit Violation		Ammonia, pH, E. Coli water quality issues	1% Probability	1.00%	1.00%
Temporary Reduced Capacity, <Half Capacity		Critical Equipment Failures, Piping Failure	Equipment 2.0% to 5% based on age and lifespan	2.00%	3.13%
Out of Service, 1 day to 2 weeks		Major/Multiple Critical Equipment Failures, Piping Failure	Equipment 0.5% to 5% based on age and lifespan, Forcemain Separate	2.12%	3.35%
Out of Service, >2 weeks		Tornado, Critical Fire, Terrorism	Tornado 0.1%, Fire 0.1% to 2% based on age, Terrorism 0.1%	0.30%	1.02%
Average Probability of Consequences			84.98%	1.36%	2.12%
Component		Capacity, MGD	Number of Trains	O&M Start	O&M Stop
Alternative 3 - 0/42/0	Plant 1	0		1987	2021
	Plant 1	0		2022	2060
	Plant 2	40		1987	2027
	Plant 2	42		2028	2060
	Plant 5	3		2010	2021
	Plant 5	0		2022	2060
	Force Main Now	Raw		1957	2019
	Force Main Future	Raw		2020	2060
Consequences		Event Types	Methodology	Min.	Mean
Permit Violation		Ammonia, pH, E. Coli water quality issues	1% Probability	1.00%	1.00%
Temporary Reduced Capacity, <Half Capacity		Critical Equipment Failures, Piping Failure	Equipment 2.0% to 5% based on age and lifespan	2.36%	3.45%
Out of Service, 1 day to 2 weeks		Major/Multiple Critical Equipment Failures, Piping Failure	Equipment 0.5% to 5% based on age and lifespan, Forcemain Separate	2.48%	3.59%
Out of Service, >2 weeks		Tornado, Critical Fire, Terrorism	Tornado 0.1%, Fire 0.1% to 2% based on age, Terrorism 0.1%	0.53%	1.22%

Average Probability of Consequences			92.53%	1.59%	2.31%	
Component		Capacity, MGD	Number of Trains	O&M Start	O&M Stop	
Alternative 4 - 0/42/0 Early	Plant 1	0		1987	2021	
	Plant 1	0		2022	2060	
	Plant 2	40		1987	2021	
	Plant 2	42		2022	2060	
	Plant 5	3		2010	2021	
	Plant 5	0		2022	2060	
	Force Main Now	Raw		1957	2019	
	Force Main Future	Raw		2020	2060	
	Consequences		Event Types	Methodology	Min.	Mean
	Permit Violation	Ammonia, pH, E. Coli water quality issues	1% Probability	1.00%	1.00%	
Temporary Reduced Capacity, <Half Capacity	Critical Equipment Failures, Piping Failure	Equipment 2.0% to 5% based on age and lifespan	2.00%	3.13%		
Out of Service, 1 day to 2 weeks	Major/Multiple Critical Equipment Failures, Piping Failure	Equipment 0.5% to 5% based on age and lifespan, Forcemain Separate	2.12%	3.35%		
Out of Service, >2 weeks	Tornado, Critical Fire, Terrorism	Tornado 0.1%, Fire 0.1% to 2% based on age, Terrorism 0.1%	0.30%	1.02%		
Average Probability of Consequences		84.98%	1.36%	2.12%		
Component		Capacity, MGD	Number of Trains	O&M Start	O&M Stop	
Alternative 5 - 24/12/6	Plant 1	0		1987	2027	
	Plant 1	24		2028	2060	
	Plant 2	40		1987	2027	
	Plant 2	12		2028	2060	
	Plant 5	3		2010	2027	
	Plant 5	6		2028	2060	
	Force Main Now	Raw		1957	2030	
	Force Main Future	Ext		2031	2060	
	Consequences		Event Types	Methodology	Min.	Mean
	Permit Violation	Ammonia, pH, E. Coli water quality issues	1% Probability	1.00%	1.00%	
Temporary Reduced Capacity, <Half Capacity	Critical Equipment Failures, Piping Failure	Equipment 2.0% to 5% based on age and lifespan	2.00%	3.19%		
Out of Service, 1 day to 2 weeks	Major/Multiple Critical Equipment Failures, Piping Failure	Equipment 0.5% to 5% based on age and lifespan, Forcemain Separate	0.77%	3.33%		
Out of Service, >2 weeks	Tornado, Critical Fire, Terrorism	Tornado 0.1%, Fire 0.1% to 2% based on age, Terrorism 0.1%	0.30%	1.05%		
Average Probability of Consequences		85.66%	1.09%	2.14%		
Component		Capacity, MGD	Number of Trains	O&M Start	O&M Stop	
Alternative 6 - 24/12/6 Early	Plant 1	0		1987	2021	
	Plant 1	24		2022	2060	
	Plant 2	40		1987	2021	
	Plant 2	12		2022	2060	
	Plant 5	3		2010	2021	
	Plant 5	6		2022	2060	
	Force Main Now	Raw		1957	2024	
	Force Main Future	Ext		2025	2060	
	Consequences		Event Types	Methodology	Min.	Mean
	Permit Violation	Ammonia, pH, E. Coli water quality issues	1% Probability	1.00%	1.00%	
Temporary Reduced Capacity, <Half Capacity	Critical Equipment Failures, Piping Failure	Equipment 2.0% to 5% based on age and lifespan	2.00%	3.13%		
Out of Service, 1 day to 2 weeks	Major/Multiple Critical Equipment Failures, Piping Failure	Equipment 0.5% to 5% based on age and lifespan, Forcemain Separate	0.77%	2.89%		
Out of Service, >2 weeks	Tornado, Critical Fire, Terrorism	Tornado 0.1%, Fire 0.1% to 2% based on age, Terrorism 0.1%	0.30%	1.02%		
Average Probability of Consequences		80.44%	1.09%	2.01%		
Component		Capacity, MGD	Number of Trains	O&M Start	O&M Stop	
Plant 1		0		1987	2027	

Alternative 7 - 24/18/0	Plant 1	24		2028	2060
	Plant 2	40		1987	2027
	Plant 2	18		2028	2060
	Plant 5	3		2010	2021
	Plant 5	0		2060	2060
	Force Main Now	Raw		1957	2030
	Force Main Future	Ext		2031	2060
Alternative 8 - 24/18/0 Early	Consequences		Event Types	Methodology	Min. Mean
	Permit Violation	Ammonia, pH, E. Coli water quality issues		1% Probability	1.00% 1.00%
	Temporary Reduced Capacity, <Half Capacity	Critical Equipment Failures, Piping Failure		Equipment 2.0% to 5% based on age and lifespan	2.00% 3.19%
	Out of Service, 1 day to 2 weeks	Major/Multiple Critical Equipment Failures, Piping Failure		Equipment 0.5% to 5% based on age and lifespan, Forcemain Separate	0.77% 3.33%
	Out of Service, >2 weeks	Tornado, Critical Fire, Terrorism		Tornado 0.1%, Fire 0.1% to 2% based on age, Terrorism 0.1%	0.30% 1.05%
	Average Probability of Consequences			85.66%	1.09% 2.14%
	Component	Capacity, MGD	Number of Trains	O&M Start	O&M Stop
Alternative 9 - 24/15/3	Plant 1	0		1987	2021
	Plant 1	24		2022	2060
	Plant 2	40		1987	2021
	Plant 2	18		2022	2060
	Plant 5	3		2010	2021
	Plant 5	0		2060	2060
	Force Main Now	Raw		1957	2024
	Force Main Future	Ext		2025	2060
arly	Consequences		Event Types	Methodology	Min. Mean
	Permit Violation	Ammonia, pH, E. Coli water quality issues		1% Probability	1.00% 1.00%
	Temporary Reduced Capacity, <Half Capacity	Critical Equipment Failures, Piping Failure		Equipment 2.0% to 5% based on age and lifespan	2.00% 3.13%
	Out of Service, 1 day to 2 weeks	Major/Multiple Critical Equipment Failures, Piping Failure		Equipment 0.5% to 5% based on age and lifespan, Forcemain Separate	0.77% 2.89%
	Out of Service, >2 weeks	Tornado, Critical Fire, Terrorism		Tornado 0.1%, Fire 0.1% to 2% based on age, Terrorism 0.1%	0.30% 1.02%
	Average Probability of Consequences			80.44%	1.09% 2.01%
	Component	Capacity, MGD	Number of Trains	O&M Start	O&M Stop
arly	Plant 1	0		1987	2027
	Plant 1	24		2028	2060
	Plant 2	40		1987	2027
	Plant 2	15		2028	2060
	Plant 5	3		2010	2021
	Plant 5	3		2022	2060
	Force Main Now	Raw		1957	2030
	Force Main Future	Ext		2031	2060
arly	Consequences		Event Types	Methodology	Min. Mean
	Permit Violation	Ammonia, pH, E. Coli water quality issues		1% Probability	1.00% 1.00%
	Temporary Reduced Capacity, <Half Capacity	Critical Equipment Failures, Piping Failure		Equipment 2.0% to 5% based on age and lifespan	2.36% 3.45%
	Out of Service, 1 day to 2 weeks	Major/Multiple Critical Equipment Failures, Piping Failure		Equipment 0.5% to 5% based on age and lifespan, Forcemain Separate	1.31% 3.68%
	Out of Service, >2 weeks	Tornado, Critical Fire, Terrorism		Tornado 0.1%, Fire 0.1% to 2% based on age, Terrorism 0.1%	0.53% 1.22%
	Average Probability of Consequences			93.44%	1.37% 2.34%
	Component	Capacity, MGD	Number of Trains	O&M Start	O&M Stop
arly	Plant 1	0		1987	2021
	Plant 1	24		2022	2060
	Plant 2	40		1987	2021
	Plant 2	15		2022	2060

Alternative 10 - 24/15/3 E

Plant 5	3	2010	2021
Plant 5	3	2022	2060
Force Main Now	Raw	1957	2024
Force Main Future	Ext	2025	2060

Consequences	Event Types	Methodology	Min.	Mean
Permit Violation	Ammonia, pH, E. Coli water quality issues	1% Probability	1.00%	1.00%
Temporary Reduced Capacity, <Half Capacity	Critical Equipment Failures, Piping Failure	Equipment 2.0% to 5% based on age and lifespan	2.00%	3.13%
Out of Service, 1 day to 2 weeks	Major/Multiple Critical Equipment Failures, Piping Failure	Equipment 0.5% to 5% based on age and lifespan, Forcemain Separate	0.77%	2.89%
Out of Service, >2 weeks	Tornado, Critical Fire, Terrorism	Tornado 0.1%, Fire 0.1% to 2% based on age, Terrorism 0.1%	0.30%	1.02%
Average Probability of Consequences		80.44%	1.09%	2.01%

Alternative	Cumulative (Area under Risk Profile)	Min.	Mean
1	92.53%	1.59%	2.31%
2	84.98%	1.36%	2.12%
3	92.53%	1.59%	2.31%
4	84.98%	1.36%	2.12%
5	85.66%	1.09%	2.14%
6	80.44%	1.09%	2.01%
7	85.66%	1.09%	2.14%
8	80.44%	1.09%	2.01%
9	93.44%	1.37%	2.34%
10	80.44%	1.09%	2.01%

		50	14.00%	16.00%	18.00%	20.00%	22.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
		50	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.00%	4.00%	6.00%	8.00%	10.00%	12.00%	14.00%	16.00%	18.00%	20.00%	22.00%	24.00%
2.00%	5.00%	50	5.60%	5.66%	5.72%	5.78%	5.84%	5.90%	5.96%	6.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
0.50%	1.25%	50	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.50%	0.59%	0.68%	0.77%	0.86%	0.95%	1.04%	1.13%	1.22%	1.31%

Max.	Initial Risk	Max Risk	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
1.00%	1.00%		1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
4.04%	2.00%	5.00%	3.80%	3.86%	3.92%	3.98%	4.04%	2.00%	2.06%	2.12%	2.18%	2.24%	2.30%	2.36%	2.42%	2.48%	2.54%	2.60%	2.66%	2.72%
6.02%	0.50%	5.00%	5.60%	5.66%	5.72%	5.78%	5.84%	5.90%	5.96%	6.02%	0.77%	0.86%	0.95%	1.04%	1.13%	1.22%	1.31%	1.40%	1.49%	1.58%
1.59%	0.30%	2.20%	1.44%	1.48%	1.52%	1.55%	1.59%	0.30%	0.34%	0.38%	0.41%	0.45%	0.49%	0.53%	0.57%	0.60%	0.64%	0.68%	0.72%	0.76%
3.12%			2.96%	3.00%	3.04%	3.08%	3.12%	2.30%	2.34%	2.38%	1.09%	1.14%	1.19%	1.23%	1.28%	1.33%	1.37%	1.42%	1.47%	1.51%

Max.
3.04%
3.04%
3.04%
3.04%
3.36%
3.12%
3.36%
3.12%
3.36%
3.12%

14.00%	16.00%	18.00%	20.00%	22.00%	24.00%	26.00%	28.00%	30.00%	32.00%	34.00%	36.00%	38.00%	40.00%	42.00%	44.00%	46.00%	48.00%	50.00%	52.00%	54.00%	56.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
14.00%	16.00%	18.00%	20.00%	22.00%	24.00%	26.00%	28.00%	30.00%	32.00%	34.00%	36.00%	38.00%	40.00%	42.00%	44.00%	46.00%	48.00%	50.00%	52.00%	54.00%	56.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
0.86%	0.95%	1.04%	1.13%	1.22%	1.31%	1.40%	1.49%	1.58%	1.67%	1.76%	1.85%	1.94%	2.03%	2.12%	2.21%	2.30%	2.39%	2.48%	2.57%	2.66%	2.75%

2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056
1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
2.78%	2.84%	2.90%	2.96%	3.02%	3.08%	3.14%	3.20%	3.26%	3.32%	3.38%	3.44%	3.50%	3.56%	3.62%	3.68%	3.74%	3.80%	3.86%	3.92%	3.98%	4.04%
1.67%	1.76%	1.85%	1.94%	2.03%	2.12%	2.21%	2.30%	2.39%	2.48%	2.57%	2.66%	2.75%	2.84%	2.93%	3.02%	3.11%	3.20%	3.29%	3.38%	3.47%	3.56%
0.79%	0.83%	0.87%	0.91%	0.95%	0.98%	1.02%	1.06%	1.10%	1.14%	1.17%	1.21%	1.25%	1.29%	1.33%	1.36%	1.40%	1.44%	1.48%	1.52%	1.55%	1.59%
1.56%	1.61%	1.66%	1.70%	1.75%	1.80%	1.84%	1.89%	1.94%	1.98%	2.03%	2.08%	2.13%	2.17%	2.22%	2.27%	2.31%	2.36%	2.41%	2.45%	2.50%	2.55%
2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
14.00%	16.00%	18.00%	20.00%	22.00%	24.00%	26.00%	28.00%	30.00%	32.00%	34.00%	36.00%	38.00%	40.00%	42.00%	44.00%	46.00%	48.00%	50.00%	52.00%	54.00%	56.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
14.00%	16.00%	18.00%	20.00%	22.00%	24.00%	26.00%	28.00%	30.00%	32.00%	34.00%	36.00%	38.00%	40.00%	42.00%	44.00%	46.00%	48.00%	50.00%	52.00%	54.00%	56.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
26.00%	28.00%	30.00%	32.00%	34.00%	36.00%	38.00%	40.00%	42.00%	44.00%	46.00%	48.00%	50.00%	52.00%	54.00%	56.00%	58.00%	60.00%	62.00%	64.00%	66.00%	68.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
0.86%	0.95%	1.04%	1.13%	1.22%	1.31%	1.40%	1.49%	1.58%	1.67%	1.76%	1.85%	1.94%	2.03%	2.12%	2.21%	2.30%	2.39%	2.48%	2.57%	2.66%	2.75%

0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
26.00%	28.00%	30.00%	32.00%	34.00%	36.00%	38.00%	40.00%	42.00%	44.00%	46.00%	48.00%	50.00%	52.00%	54.00%	56.00%	58.00%	60.00%	62.00%	64.00%	66.00%	68.00%
0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	
1.40%	1.49%	1.58%	1.67%	1.76%	1.85%	1.94%	2.03%	2.12%	2.21%	2.30%	2.39%	2.48%	2.57%	2.66%	2.75%	2.84%	2.93%	3.02%	3.11%	3.20%	3.29%

2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056
1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%	1.00%
2.78%	2.84%	2.90%	2.96%	3.02%	3.08%	3.14%	3.20%	3.26%	3.32%	3.38%	3.44%	3.50%	3.56%	3.62%	3.68%	3.74%	3.80%	3.86%	3.92%	3.98%	4.04%
1.67%	1.76%	1.85%	1.94%	2.03%	2.12%	2.21%	2.30%	2.39%	2.48%	2.57%	2.66%	2.75%	2.84%	2.93%	3.02%	3.11%	3.20%	3.29%	3.38%	3.47%	3.56%
0.79%	0.83%	0.87%	0.91%	0.95%	0.98%	1.02%	1.06%	1.10%	1.14%	1.17%	1.21%	1.25%	1.29%	1.33%	1.36%	1.40%	1.44%	1.48%	1.52%	1.55%	1.59%
1.56%	1.61%	1.66%	1.70%	1.75%	1.80%	1.84%	1.89%	1.94%	1.98%	2.03%	2.08%	2.13%	2.17%	2.22%	2.27%	2.31%	2.36%	2.41%	2.45%	2.50%	2.55%

Wichita AMP BCE Decision Modeling - BNR

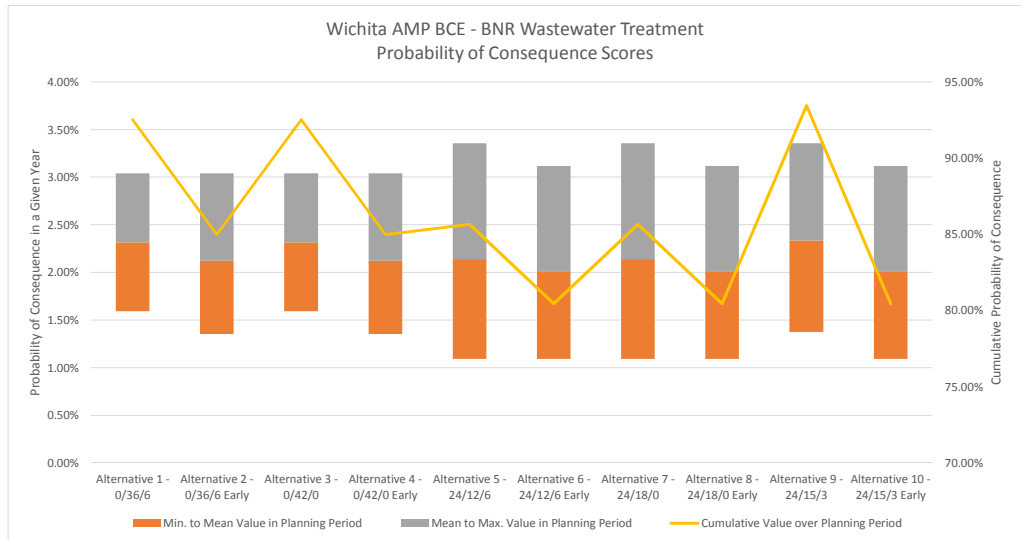
Probability of Consequence Scoring

Probability of Consequence	Alternatives									
	Alternative 1 - 0/36/6	Alternative 2 - 0/36/6 Early	Alternative 3 - 0/42/0	Alternative 4 - 0/42/0 Early	Alternative 5 - 24/12/6	Alternative 6 - 24/12/6 Early	Alternative 7 - 24/18/0	Alternative 8 - 24/18/0 Early	Alternative 9 - 24/15/3	Alternative 10 - 24/15/3 Early
Minimum Value in Planning Period	1.59%	1.36%	1.59%	1.36%	1.09%	1.09%	1.09%	1.09%	1.37%	1.09%
Mean Value in Planning Period	2.31%	2.12%	2.31%	2.12%	2.14%	2.01%	2.14%	2.01%	2.34%	2.01%
Maximum Value in Planning Period	3.04%	3.04%	3.04%	3.04%	3.36%	3.12%	3.36%	3.12%	3.36%	3.12%
Cumulative Value over Planning Period	92.53%	84.98%	92.53%	84.98%	85.66%	80.44%	85.66%	80.44%	93.44%	80.44%

Instructions:

- 1) Alternatives should match and be pulled from the "Service Benefit" tab.
- 2) Edit the PV rate and years, cells C8 and C9, highlighted in yellow.
- 3) Edit the Project Capital Cost and Annual O&M Cost, highlighted in yellow, for each alternative. Values should be in current year dollar values. Costs should include all costs associated with land purchasing, permits, engineering, construction, inspection, engineering services during construction, startup, warranty, power, chemicals, labor, City internal project management costs, etc.

Weighted benefit scores should match and be pulled from the "Service Benefit" tab. A favorable alternative should have a high benefit to Normalized PV Cost or a low PV Cost to benefit.



Zero, for chart purposes

Zero to Min. Value in Planning Period

Min. to Mean Value in Planning Period

Mean to Max. Value in Planning Period

0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
1.59%	1.36%	1.59%	1.36%	1.09%	1.09%	1.09%	1.09%	1.37%	1.09%
0.72%	0.77%	0.72%	0.77%	1.05%	0.92%	1.05%	0.92%	0.96%	0.92%
0.73%	0.91%	0.73%	0.91%	1.21%	1.11%	1.21%	1.11%	1.02%	1.11%

Wichita AMP BCE Decision Modeling - BNR

		Ranking of Alternatives									
Probability of Consequence	Desired Value	Alternatives									
		Alternative 1 - 0/36/6	Alternative 2 - 0/36/6 Early	Alternative 3 - 0/42/0	Alternative 4 - 0/42/0 Early	Alternative 5 - 24/12/6	Alternative 6 - 24/12/6 Early	Alternative 7 - 24/18/0	Alternative 8 - 24/18/0 Early	Alternative 9 - 24/15/3	Alternative 10 - 24/15/3 Early
Total Plant Capacity	Highest	42	42	42	42	42	42	42	42	42	42
Benefit	Highest	4.98	5.26	3.27	3.54	8.33	8.61	5.58	5.86	7.47	7.74
Cumulative Probability of Consequence	Lowest	92.53%	84.98%	92.53%	84.98%	85.66%	80.44%	85.66%	80.44%	93.44%	80.44%
Total Present Value	Lowest	\$ 1,283,444,000	\$ 1,305,125,000	\$ 1,268,634,000	\$ 1,310,025,000	\$ 1,295,934,000	\$ 1,304,475,000	\$ 1,269,665,000	\$ 1,289,375,000	\$ 1,274,065,000	\$ 1,293,775,000
Total Present Value / Total Plant Capacity	Lowest	\$ 30,558,190	\$ 31,074,405	\$ 30,205,571	\$ 31,191,071	\$ 30,855,571	\$ 31,058,929	\$ 30,230,119	\$ 30,699,405	\$ 30,334,881	\$ 30,804,167
Benefit / Normalized Total Present Value	Highest	4.92	5.11	3.27	3.43	8.16	8.37	5.57	5.76	7.43	7.59
Total Present Value / Benefit	Lowest	\$ 257,840,000	\$ 248,340,000	\$ 388,360,000	\$ 369,600,000	\$ 155,520,000	\$ 151,490,000	\$ 227,630,000	\$ 220,200,000	\$ 170,640,000	\$ 167,060,000
Cumulative Prob. Of Cons. * Normalized TPV	Lowest	93.61%	87.42%	92.53%	87.75%	87.51%	82.71%	85.73%	81.75%	93.83%	82.03%
TPV / Cumulative Probability of Consequence	Lowest	\$ 141,426,336,088	\$ 15,427,009,456	\$ 139,794,380,165	\$ 15,484,929,078	\$ 16,672,250,096	\$ 10,036,353,145	\$ 16,334,298,212	\$ 9,920,176,957	N/A	\$ 9,954,029,621
Rankings											
Benefit	Lowest	8	7	10	9	2	1	6	5	4	3
Cumulative Probability of Consequence	Lowest	8	4	8	4	6	1	6	1	10	1
Total Present Value	Lowest	4	9	1	10	7	8	2	5	3	6
Total Present Value / Total Plant Capacity	Lowest	4	9	1	10	7	8	2	5	3	6
Benefit / Normalized Total Present Value	Lowest	8	7	10	9	2	1	6	5	4	3
Total Present Value / Benefit	Lowest	8	7	10	9	2	1	6	5	4	3
Cumulative Prob. Of Cons. * Normalized TPV	Lowest	9	5	8	7	6	3	4	1	10	2
TPV / Cumulative Probability of Consequence	Lowest	9	4	8	5	7	3	6	1	10	2
Non-Economic Total Ranking Scores	Lowest	16	11	18	13	8	2	12	6	14	4
Economic Total Ranking Scores	Lowest	42	41	38	50	31	24	26	22	34	22
Total Rank Scores	Lowest	58	52	56	63	39	26	38	28	48	26
Non-Economic Rank	Lowest	9	5	10	7	4	1	6	3	8	2
Economic Rank	Lowest	9	8	7	10	5	3	4	1	6	1
Overall Rank	Lowest	9	7	8	10	5	1	4	3	6	1